Attorney's Docket No. 1033275-000419

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	Mail Stop Amendment
Alexander Schnell et al.	Group Art Unit: 1742
Application No.: 10/726,542	Examiner: SCOTT R KASTLER
Filed: December 4, 2003	Confirmation No.: 7667
For: NON-DESTRUCTIVE TESTING METHOD OF DETERMINING THE DEPLETION OF A COATING	

DECLARATION BY ALEXANDER SCHNELL UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

1. I am one of the named co-inventors in the above-identified application ("the present application").

2. As indicated in my attached curriculum vitae, I earned a PhD from the University of Lausanne EPFL. I have been employed in the technical area of turbomachinery at ABB and Alstom since 1988. I have also co-authored published technical papers and received European patents related to the field of turbomachinery, including gas turbine materials and processes.

3. Current claim 1 of the present application is directed to a method of determining the depletion of Al and Cr of a γ/γ' MCrAlY-coating of a component after use in a high temperature environment. The claimed method comprises, *inter alia*, (a) using a component having a γ/γ' MCrAlY-coating in a high-temperature environment in which the γ/γ' MCrAlY-coating exhibits an equilibrium γ/γ'-

microstructure, (b) cooling the component to a temperature lower than the operation temperature such that the γ/γ' MCrAlY-coating exhibits a non-equilibrium γ/γ'-microstructure at room temperature, and (c) applying a defined annealing heat treatment to the γ/γ' MCrAlY-coated component to transform the non-equilibrium high temperature γ/γ'-microstructure into the equilibrium room temperature microstructure with a α-Cr phase" (emphasis added). The method recited in claim 1 further comprises "(d) measuring qualitatively impedance curves or the electrical conductivity and magnetic permeability of the MCrAlY-coating by means of a multi-frequency eddy current system, and (e) determining the Al and/or Cr depletion of the coating from the measured impedance curves or coating conductivity and permeability." As discussed below, the "defined annealing heat treatment" recited in claim 1, clause (c), is different from the "standard heat treatment" described in the present application.

4. Upon information and belief: Components, e.g., blades and vanes, used in the hot gas path of turbines can be made from nickel-based superalloys. During the manufacturing of these components, a sequence of heat treatments is performed in order to fully exploit the mechanical properties of the nickel-based superalloys. Each type of superalloy used for these components requires a specific heat treatment, which is typically recommended by the alloy supplier. In most cases, the specific heat treatment for a superalloy includes several individual heat treatment steps. For example, the heat treatment may include the following steps: (a) solution heat treatment (typically at a temperature of ~1180°C - 1290°C); (b) first precipitation

step (typically at ~ 1080°C - 1160°C); and (c) second precipitation step (typically at ~ 850°C-870°C).

5. Upon information and belief: In the gas turbine industry, the term "standard heat treatment" commonly refers to heat treatments that are applied to specific superalloys. In this usage in the gas turbine art, the term "standard" means a heat treatment that is associated with a particular superalloy composition.

6. Upon information and belief: Gas turbine components require a protective coating. After a protective coating has been applied to a given gas turbine component, the coated component is then heat treated in order to properly bond the coating to the underlying parent superalloy material. The as-coated component is given a "standard heat treatment." Accordingly, the specific conditions of the heat treatment of the as-coated component depend on the particular parent superalloy material.

7. At page 5, lines 20-22, of the present application, it is described that "after the <u>standard heat treatment</u> (1120°C/2h + 870/20h) the SV20 coating shows a microstructure consisting of a γ-Ni matrix with the Al rich γ' phase and Cr-rich α-Cr phase" (emphasis added). A "standard heat treatment" is also described at page 7, lines 6-7, of the present application, with regard to SV20/MarM247.

8. Upon information and belief: The term "standard heat treatment" described at page 5, line 20; and page 7, lines 6-7, of the present application,

pertains to the standard heat treatment used for the parent superalloy material on which the coating is applied, not to a heat treatment for the coating. There exists no standard heat treatment for the MCrAlY coating itself. This statement applies to all sprayed MCrAlY coatings used on blades and vanes in the hot gas path of turbines. Accordingly, the term "standard heat treatment" is not relevant to the MCrAlY coatings. As explained at point (6) above, after a gas turbine component has been coated, the as-coated component is heat treated. The heat treatment applied to the coated component is the standard heat treatment (first and second precipitation steps) that is designed for the parent base material. Basically, two heat treatments, i.e., a coating diffusion heat treatment (which in most cases is the first precipitation step for the superalloy, as discussed above at point (4)) + a standard heat treatment for the parent base material, are merged. Consequently, because the standard heat treatment depends on the particular parent superalloy material that is coated, the heat treatment conditions for the merged heat treatments that are applied to as-coated gas turbine components will change for components made from different parent superalloy materials.

9. Upon information and belief: After a gas turbine component has been used in a high temperature environment (i.e., the component is in an "ex-service condition"), the "ex-service" gas turbine component can be evaluated to determine the depletion of Al and Cr of a γ/γ' MCrAlY-coating of a component using a multi-frequency eddy current system ("the FSECT technique"), as described at page 7, line 21, to page 8, line 12, of the present application.

10. Upon information and belief: Typically, with regard to information backflow and performance of an ex-service component, one skilled in the art would not subject an ex-service component to a heat treatment because this heat treatment would, in effect, blur or distort the information that is stored in the component's microstructure.

11. The present inventors determined that, in order to be able to properly apply the FSECT technique to a γ/γ′ MCrAlY-coated component that has been used in a high temperature environment (i.e., to apply the FSECT technique to obtain a reliable assessment of the γ/γ′ MCrAlY coating), the component needs to be heat treated according to the step recited in claim 1, clause (c). The present inventors determined that subjecting an ex-service γ/γ′ MCrAlY-coated component to the claimed heat treatment unexpectedly provides a solution to the unreliable coating assessment problems associated with the FSECT technique.

12. Upon information and belief: The heat treatment recited in claim 1, clause (c), is different from a "standard heat treatment" that is applied during the manufacturing of gas turbine components to produce new components (i.e., components that have not been used in service). The heat treatment recited in claim 1, clause (c), is performed for the purpose of determining information about the physical properties of the coating. In contrast, there exists no "standard" heat treatment for coatings. Consequently, it would not have been obvious to one skilled in the art to apply a heat treatment to a γ/γ′ MCrAlY coating of a component, with the

coating in the ex-service condition, much less to apply the heat treatment recited in claim 1, clause (c).

13. In the Office Action dated December 29, 2005, in the present application, the Examiner states that:

> Because the turbine blades of both of Antonelli and Antonelli et al. would also desire the improved properties afforded by the alloy and heat treatment of the admitted prior art of the instant disclosure, motivation to employ the MCrAlY alloy and heat treatment of the admitted prior art of the instant disclosure as the alloy and heat treatment of either of Antonelli and Antonelli et al. in order to restore the serviced coatings of either of Antonelli or Antonelli et al. would have been modification obvious to one of ordinary skill in the art at the time the invention was made. (Emphasis added).

14. Upon information and belief: The standard heat treatments described at page 5, line 20, and at page 7, lines 6-7, of the present application, are applied to the as-coated component to fully exploit the mechanical properties of the parent superalloy material. There are heat treatments known for the reconditioning of ex-service components in order to restore the mechanical properties of the ex-service components, i.e., the microstructure of the components. These heat treatments are not, however, performed for the same purpose as the heat treatment recited in claim 1, clause (c), which is to overcome the unreliable coating assessment problem associated with using the FSECT technique.

15. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: March 15, 2006 By: Alexander Schnell
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Alexander SCHNELL, PhD.

Curriculum Vitae

Personal Data

Date of Birth: 7th Jan. 1972
Nationality: Austria
Residence: C permit for Switzerland
Martial Status: Single
Languages: German, English

PROFESSIONAL Data

ALSTOM Turbomachinery, Baden (CH)

- 8 years working experience in the field of Turbomachinery
- 5 years experience as Project Leader
- Expert in Turbine Materials
- Specialized on Turbine Maintenance & Reconditioning
- Turbine Sealing systems & materials

Project Leader – Main Tasks

- Development of validated repair processes
- Leadership of cross-disciplinary project groups
- Collaboration with international partners

Alexander Schnell, Bäderstrasse 24, CH-5400 Baden

PROFESSIONAL EXPERIENCE

Since August 2003 **ALSTOM – Expert Development Program**

- Nominated to participate in internal Expert Development Program
- Work as Senior Engineer & Technical Support for R&D Projects
- Daily Technical Troubleshooting, internal Consultancy
- Qualified Expertise in Gas Turbine Materials & Processes
  - GT part Manufacturing Processes
  - Reconditioning, Maintenance & Retrofit processes
  - Turbine Sealing systems & materials
  - Protective Coatings & TBC

Since April 2000 **Project Leader – ALSTOM Power Gas Turbines**

- R & D Project allocation and definition
- Coordination of cross-disciplinary project groups
- Delivery of validated processes & specifications
- Development of Abradable/Abrasive Sealing Systems

July 1998 – April 2000 **ABB Gas Turbines Research Centre – Baden**

- Research work on joining techniques for GT materials
- Alloy development for brazing and Laser welding

EDUCATION

July 2000 to June 2004 **Doctoral Thesis at the University of Lausanne EPFL**

"A study of the Diffusion Brazing Process applied to the Single Crystal Superalloy CMSX-4"

Oct. 1990 to June 1998 **Study of Materials Science, University of Leoben (A)**

Aug. 1997 – Jan. 1998 **Diploma work with the ABB Research Centre Baden**

"Improvement of the Investment Casting Process of Single Crystal Gas Turbine Blades using the Modeling Tool CASTS"

Jan. 1996 – Sept. 1996 **University of Sheffield (UK)**

Erasmus Student Exchange Program

Oct. 1982 to June 1990 **Humanistic Gymnasium St.Rupert, Bischofshofen (A)**

Published Papers

- **Single crystal braze repair of Single Crystal Gas Turbine components**

  A. Schnell and D. Graf: Proceedings of the 6th International Charles Parsons Turbine Conference, IOM, Dublin, Ireland, (2003), pp. 971-85.

  (Awarded at the Conference: Best Paper on Gas Turbine Technology)

- **Epitaxial deposition of MCrAlY coatings on a Ni-based superalloy by Laser Cladding**
  C. Bezençon, A. Schnell, W. Kurz: Scripta Materiala 49, (2003), pp. 705 – 709.

- **Application of a Frequency Scanning Eddy Current System for quality control on high-temperature Brazing repair technique**

  K. Germerdonk, A. Schnell and G. Antonelli (CESI): PowerGen Europe, Power Generation Conference, Düsseldorf, Germany, (2002)

- **Robot Guided Laser Repair of Single Crystal Turbine Blades**

  M. Hoebel, B. Fehrmann and A. Schnell: PowerGen Europe, Power Generation Conference, Düsseldorf, Germany, (2002)

- **Single crystal Coating of SX Turbine Blades by a Laser Cladding Technique**

  C. Bezençon, J.D. Wagnière, M. Hoebel, A. Schnell, M. Konter and W. Kurz: Proc. of the 7th Liège Conference (2002), pp. 1503-1511

- **Prediction and Measurement of Microsegregation and Microstructural Evolution of Directionally Solidified Superalloys**
  B. Böttger, U. Grafe, D. Ma and A. Schnell: Superalloys 2000, 9th International Symposium on Superalloys, Champion, Pennsylvania, September 17-21, 2000. Ed. by T. M. Pollock (et. al.), Warrendale : TMS, 2000, p. 313-322.

Granted Patents

- EP 1 258 545: "Method for isothermal brazing of single crystal components"

- EP 1 491 650 B1: "A method of depositing a coating system"